2.0 HISTORICAL USES

PRINCIPAL FINDINGS

- Lead scavengers have been used in leaded gasoline since the 1920s.
- EDB was used as an agricultural pesticide from 1948 until 1993.
- Although leaded gasoline has been banned in on-road vehicles since 1996, it is still used in certain off-road applications such as aviation gasoline (Avgas) and automobile racing fuel and both of these fuels also contain lead scavengers.

Lead scavengers are compounds added to leaded gasoline to prevent buildup of lead deposits that foul internal combustion engines. In this capacity, EDB and EDC are referred to as "lead scavengers". Even though leaded gasoline has not been used for on-road automobiles for more than a decade, lead compounds (and, therefore, lead scavengers) are still in use in aviation gasoline (Avgas) and in some off-road applications such as racing fuel.

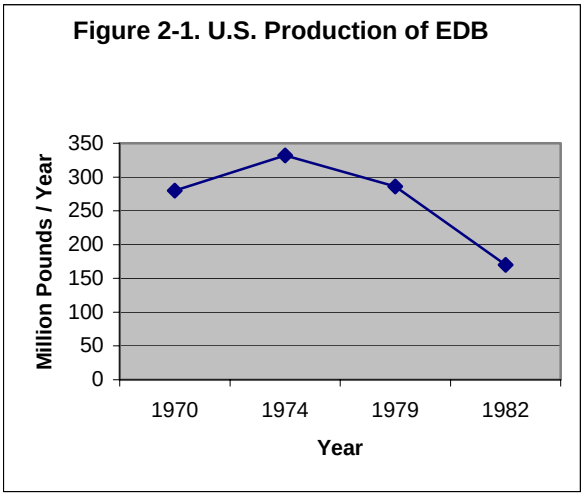
In addition, EDB was used as a pesticide and fumigant. EDC was used as a fumigant, in varnish and finish removers, in soaps and scouring compounds, in organic synthesis for extraction and cleaning purposes, in metal degreasers, in ore floatation, and in paints, coatings and adhesives. EDB is also used as a chemical intermediate in synthesis and as a nonflammable solvent for resins, gums, and waxes. EDC is now primarily used to manufacture vinyl chloride. This section summarizes the historical uses and consumption patterns of EDB and EDC as well as the phaseout of EDB. The historical production and consumption patterns were obtained from the Hazardous Substance Databank, a database of the National Library of Medicine's TOXNET system (http://toxnet.nlm.nih.gov).

2.1 HISTORICAL PRODUCTION OF EDB AND EDC

In the 1970s, production of EDB in the United States averaged 280 million pounds per year. The production volume of EDB in 1974 was 332 million pounds, and in 1979, the production volume was 285.9 million pounds. With increased government regulation and restriction of the use of EDB, production steadily decreased. By 1982, U.S. production of EDB reached a low of 169.8 million pounds (see Figure 2-1). Data on the production of EDB after 1982 are not available. The production volumes of EDC in the United States are presented in Figure 2-2.

2.2 USE OF EDB AND EDC AS LEAD SCAVENGERS

Premature ignition (knocking) in gasoline engines encouraged the development of lead antiknock agents. However, the use of lead antiknock agents in gasoline caused engine fouling because lead deposits formed within the combustion chamber. These deposits could flake off and prevent valves from being fully seated, which causes them to burn. To overcome the problem of engine fouling, lead scavengers were added to all leaded gasolines. Commercial sale of leaded gasoline



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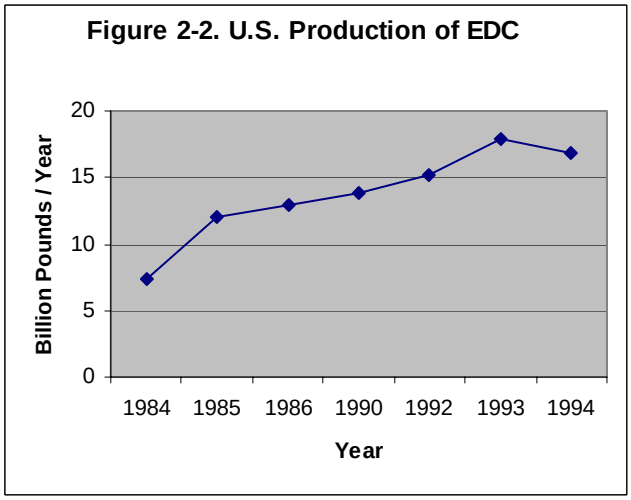

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containing triethylbromide and carbon tetrachloride as lead scavengers began in 1923. Later carbon tetrachloride was replaced by trichloroethene. The use of EDB as a lead scavenger began in 1925. Beginning in the 1940s, EDB was partially replaced with EDC as a cost saving measure (Ref. 2-7). In 1981, 83 percent of the EDB produced was used for lead scavengers (Ref. 2-4). The most commonly used lead antiknock packages contain either tetraethyl lead (TEL) or tetramethyl lead (TML), both of which contained EDB and EDC. The compositions of TEL and TML are presented in Table 2-1 (Ref. 2-6).

Table 2-1: Composition of Lead Antiknock Packages

Compound	Composition (wt%)	
	TEL Package	TML Package
Lead alkyl	61.5	50.8
EDB	17.9	17.9
EDC	18.8	18.8
Dye, diluent, inhibitor, etc.	1.8	12.5
Lead content	39.39	39.39

Source: Ref. 2-6
Note: wt% = Percentage by weight

In 1973, EPA initiated a "phasedown" program for leaded gasoline. This program was designed to reduce lead content from 2.0 grams per gallon to 0.5 gram per gallon in large refineries by 1980 and in small refineries by 1982 (Ref. 2-14). The program allowed refineries to average their total (both leaded and unleaded) gasoline output to achieve the 0.5-gram per gallon standard. In 1982, EPA lowered the standard for lead in fuel to 1.10 grams per gallon and eliminated the provision that allowed refineries to average their total leaded and unleaded gasoline output to meet the standard. In 1986, the standard was further reduced to 0.10 gram per gallon (Refs. 2-8 and 2-9). By 1995, sales of leaded gasoline were reduced to 0.6 percent of total gasoline sales. Effective January 1, 1996, the Clean Air Act banned the sale of leaded fuel for

on-road vehicles (Ref. 2-10). However, certain blends of automobile racing fuel continue to use alkyl lead compounds as a component of the fuel and EDB continues to be used as a lead scavenger in aviation gasoline (Avgas). Table 2-2 summarizes the allowable gasoline lead content from 1973 to 1996.

Table 2-2: Gasoline Lead Content

Year	Lead Content
1973	2.0 grams per gallon
1982	1.10 grams per gallon
1986	0.10 grams per gallon
1996	Banned for on-road vehicle use

Source: Refs. 2-8, 2-9, and 2-14

2.3 OTHER USES OF EDB AND EDC

In addition to their use as lead scavengers, EDB and EDC also have been used for other purposes, as discussed below.

2.3.1 EDB as a Pesticide and Fumigant

The second largest use of EDB was as a soil fumigant to protect citrus, vegetable, and grain crops against insects, pests, and nematodes. EDB was also widely used as a fumigant on golf courses. EDB has been registered as a pesticide since 1948. In 1977, approximately 300 million pounds of EDB was produced annually in the United States; approximately 20 million pounds was used as a pesticide, and approximately 280 million pounds was used in leaded gasoline. Of the 20 million pounds used as a pesticide, 90 percent was used as a soil fumigant, and the rest was used to fumigate stored grain, grain milling machinery, and quarantined citrus and other tropical fruits (Refs. 2-1 and 2-11).

2.3.2 Phaseout of EDB as a Fumigant

In 1977, based on evidence that EDB posed cancer risks, EPA began a Rebuttable Presumption Against Registration (RPAR) review[1]. In December 1980, after further research into the use of EDB, the agency issued a proposed decision to cancel use of the pesticide for fumigation of stored grain, milling machinery, and felled logs and to phase out its use for quarantine fumigation over a period of 2 years. On September 30, 1983, EPA ordered an immediate emergency suspension of the use of EDB as a soil fumigant for agricultural crops (Ref. 2-11). The last registered product containing EDB as a garment fumigant was Tri-X-Garment Fumigant, whose production was cancelled on September 8, 1993 (Ref. 2-12).

[1] The RPAR review process is started when EPA has evidence that a pesticide may cause unreasonable adverse effects in humans or the environment.

2.3.3 Current Uses of EDB

EDB is used as a chemical intermediate in synthesis operations and as a nonflammable solvent for resins, gums, and waxes. The most common chemical made from EDB is vinyl bromide, which is used as a flame retardant in modacrylic fibers. EDB is also used as an intermediate in the preparation of dyes and pharmaceuticals (Ref. 2-1).

Because leaded fuel is still used for some off-road applications (e.g., automobile racing fuel, aviation gasoline-Avgas) lead scavengers are still in use and potentially stored in underground storage tanks.

2.3.4 EDC as a Solvent and Fumigant

Commercial production of EDC in the United States was first reported in 1922. EDC was used in varnish and finish removers, in soaps and scouring compounds, in organic synthesis for extraction and cleaning purposes, in metal degreasers, in ore floatation, and in paints, coatings and adhesives. In 1986, approximately 85 percent of the EDC made was used in the production of vinyl chloride; 10 percent was used in the production of chlorinated solvents; and 5 percent was used for various other processes, mainly the synthesis of ethylene diamines (Ref. 2-2). By 2001, approximately 94 percent of the EDC made was used in the production of vinyl chloride. The remaining EDC was used to produce ethyleneamines (3 percent); 1,1,1-trichloroethane (1 percent); vinylidine chloride (1 percent); and miscellaneous chemicals, including trichloroethene and tetrachloroethene. EDC was also used as a grain, household, and soil fumigant. The last registered product containing EDC as a garment fumigant was Tri-X-Garment Fumigant, whose production was cancelled on September 8, 1993 (Ref. 2-13).

2.3.5 Current Uses of EDC

EDC has been replaced as a solvent and degreaser by less toxic compounds. Approximately 98 percent of the EDC currently made is used to produce vinyl chloride, a monomer used in the production of polyvinyl chloride. Smaller amounts of EDC are used in the synthesis of vinylidene chloride; 1,1,1-trichloroethane; trichloroethene; tetrachloroethene; aziridines; ethylene diamines; and in chlorinated solvents (Ref. 2-2).

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